

AD-A045 018

COMSTOCK AND WESTCOTT INC CAMBRIDGE MASS
MODIFICATION OF A SOLAR EUV SPECTROMETER.(U)
JUL 77 J F MCGRATH, J P PADUR

F/G 14/2

UNCLASSIFIED

AFGL-TR-77-0145

F19628-76-C-0041

NL

1 OF 2
AD
A045018



END
DATE
FILMED
10-77
DDC

CONT.

1 OF 2
AD

A045018



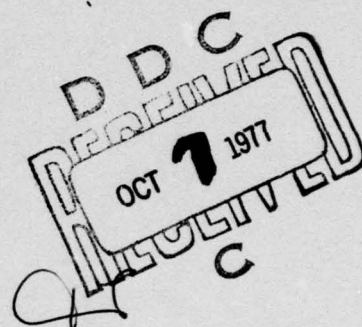
AD A 045018

AFGL-TR-77-0145

MODIFICATION OF A SOLAR EUV SPECTROMETER

John F. McGrath
Joseph P. Padur

Comstock & Wescott, Inc.
765 Concord Avenue
Cambridge, Massachusetts 02138



31 July 1977

Final Report for Period 1 November 1975 - 30 June 1977

Approved for public release; distribution unlimited.

AD No. _____
DDC FILE COPY

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

Qualified requestors may obtain additional copies from the Defense Documentation Center. All others should apply to the National Technical Information Service.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER (18) AFGL-TR-77-0145	2. GOVT ACCESSION NO.	3. PERFORMER'S CATALOG NUMBER (9) <i>rept</i>
4. TITLE (and Subtitle) (6) MODIFICATION OF A SOLAR EUV SPECTROMETER	5. TYPE OF REPORT & PERIOD COVERED Final - 1 Nov 1975 - 30 June 1977	
6. PERFORMING ORG. REPORT NUMBER		7. CONTRACT OR GRANT NUMBER(s) (15) F19628-76-C-0041 <i>mu</i>
9. PERFORMING ORGANIZATION NAME AND ADDRESS Comstock & Wescott, Inc. 765 Concord Avenue Cambridge, Massachusetts 02138		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62101F (16) 66880601 (17) 06
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Geophysics Laboratory Hanscom AFB, Massachusetts 01731 Monitor/Charles W. Chagnon/LKO		12. REPORT DATE (11) 31 July 1977
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 23 <i>12/22p.</i>
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES <i>094 400</i>		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Extreme Ultraviolet, Ultraviolet, Monochromators, Spectrometers, Spectrophotometers, Photometers, Instrumentation, Rockets, Detectors, Vacuum, Upper Atmosphere Physics, Solar Radiation, Ground Support Equipment (GSE), Electronics, Flight Electronics.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes the modification of a solar extreme ultraviolet double spectrometer (RM-60) for sounding rockets. This instrument is of the grazing-incidence grating spectrometer design. This report also covers the modification of the existing ground support equipment (GSE) as well as the auxiliary experiment.		

TABLE OF CONTENTS

1.	GENERAL	1
2.	RELATED CONTRACTS	3
3.	ROCKET SPECTROMETER NO. 60-B	5
3.1	General	5
3.2	Redesign and Fabrication	5
3.3	Modifications	6
3.3.1	Top Deck	6
3.3.2	Bottom Deck	7
3.3.3	Electron Spectrometer	7
3.3.4	Side Viewing Photometer	8
3.4	Assembly	8
3.4.1	RM-60-B (Mechanical)	8
3.4.2	RM-60-B (Electronic)	13
3.4.3	Auxiliary Experiments	13
3.5	Test and Delivery	14

ACCESS IN for	
145	Write Section <input checked="" type="checkbox"/>
100	Diff Section <input type="checkbox"/>
RECOMMENDED	
DISPOSITION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
SPECIAL	
A	

LIST OF TABLES

TABLE I	12
Technical Characteristics of Rocket Spectrometer No. 60-B	

LIST OF FIGURES

Figure 1	9
Internal Assembly Model 5032 EUV Spectrometer	
Figure 2	11
Channeltron Carrier Assembly	
Figure 3	15
Schematic Motor Drive/Timer RM-60B	
Figure 4	16
Timing Diagram RM-60B	
Figure 5	17
Step Generator/Drive Electron Spectrometer	

1. GENERAL

This report covers the design, development, and engineering activities of Comstock & Wescott, Inc. in support of a research program of the Air Force Geophysics Laboratory (AFGL). The work discussed in this report covers the modification of spectrometer RM-60 to convert it from a rocket-borne instrument concentrating on plage areas of the sun to one measuring full disc solar fluxes.

The principal engineers on this contract were

Mr. John F. McGrath,
Director of Mechanical Engineering, and

Mr. Joseph P. Padur,
Project Physicist.

Work in the field of electronics, including the flight electronics and ground support equipment (GSE) modification, was subcontracted to TRI-CON Associates, Inc. and was conducted under the direction of Mr. Chester G. Kuczun and Mr. Robert S. Hills. Other technical contributors to the contract were Messrs. Charles W. Peterson, William F. Burke, and George W. Guay of Comstock & Wescott, Inc., and Messrs. Norbert F. Robertie and Timothy A. Doyle of TRI-CON Associates, Inc.

2. RELATED CONTRACTS

The following contracts have preceded the contract covered by this report:

AF19(604)-1097, 1954 to 1956.

Contract concerned with development of a soft X-ray radiation source and an associated high vacuum system.

AF19(604)-1889, 1956 to 1959.

Measurements of EUV and soft X-rays.

AF19(604)-5693, 1959 to 1961.

Investigation of extreme ultraviolet solar radiation and clarification of role of photo-electron emission.

AF19(604)-7496, 1960 to 1963.

Development of a number of rocket and satellite monochromators and retarding potential detectors. Specific reference is made to the Final Report AFCRL-64-773 of this contract.

An associated contract which ran concurrently with AF19(604)-7496 was AF19(628)-2975.

This was concerned with research into the photo-emission properties of materials and with the investigation and development of various spectroscopic instruments.

AF19(628)-4317 was an extension of AF19(604)-7496.

Contract AF19(628)-5188 covered a further extension of this work.

Contract F19628-68-C-0239 covered an extension of the work performed under the former contract and preceded the work covered by this report.

Contract F19628-72-C-0048 covered a modification of a Double-Deck EUV Spectrophotometer.

Contract F19628-72-C-0254 covered design, development, and fabrication of a double spectrophotometer consisting of one grazing incidence and one normal incidence grating spectrophotometer.

Contract F19628-73-C-0253 covered design and fabrication of two double-deck solar extreme ultraviolet spectrometers.

Contract F19628-74-C-0002 covered design and fabrication of a normal-incidence extreme ultraviolet grating spectrometer.

Other contracts carried out by Comstock & Wescott in the field of space instrumentation, but not directly related to this contract, are:

AF19(628)-253 - Research directed toward Design of Instrumentation for Investigation of Aerospace by Rocket and Satellite Probe Techniques.

AF19(628)-4988 - Rocket and Satellite Probe Techniques.

F19628-68-C-0307 - Continuation of AF19(628)-4988.

F19628-72-C-0027 - Continuation of F19628-68-C-0307.

3. ROCKET SPECTROMETER NO. 60-B

3.1 General

The objective of this modification was to convert rocket spectrometer RM-60 (described in detail in AFGL-TR-76-0160) from a rocket-borne instrument concentrating on plage areas of the sun to one, RM-60-B, measuring full disc solar fluxes. The original instrument contained two scanning carriages covering the wavelength range of 55\AA to 310\AA in one deck and 220\AA to 1220\AA in the other deck. The modified instrument retained the coverage of 55\AA to 310\AA in the top deck but the bottom deck was changed to concentrate on four discrete spectral regions centered at a specific wavelength. The four center wavelengths were: 284\AA , 630\AA , 915\AA , and 1206\AA .

Some modifications also were carried out on the electronics of the auxiliary experiments of RM-60, namely, the electron spectrometer and the side-viewing photometer.

3.2 Redesign and Fabrication

In order to carry out the above requirements, some effort was afforded to redesign and fabrication of necessary components. It was necessary during the time period of this contract to investigate production problems with the CEM detector manufacturer, necessitating the purchase of new detectors for both decks of this instrument. These problems were enumerated in AFGL-TR-76-0160.

Some of the mechanical and electronics modifications listed below are dimensional changes of components thereby requiring replacement of some subassembly parts used in RM-60 whereas others are entirely new components. Where no reference is made to a specific component or assembly, it is then the same as used in RM-60. Reference therefore should be made to AFGL-TR-76-0160.

3.3 Modifications

3.3.1 Top Deck

- (a) Four new CEM detectors (purchase, test, wire, and assemble).
- (b) MgF_2 coating on the two shortest wavelength detector cones (those covering 50\AA - 101\AA and 96\AA - 159\AA).
- (c) Four .005" (.127mm) exit slits for calibration.
- (d) One .005" (.127mm) entrance slit for calibration.
- (e) One .002" (.0508mm) entrance slit for flight.
- (f) One entrance slit assembly mount.
- (g) One 5mm slit height limiter.
- (h) Rewiring of CEM units to amplifiers and harness.

3.3.2 Bottom Deck

- (a) Four new CEM detectors (purchase, test, wire, and assemble).
- (b) New carriage for four selected wavelengths.
- (c) New belt for carriage drive.
- (d) New limit switch assembly.
- (e) Four .005" (.127mm) exit slits.
- (f) One .002" (.0508mm) entrance slit.
- (g) One entrance slit assembly mount.
- (h) One 5mm slit height limiter.
- (i) Change step rate from 100 frames per second to 10 frames per second.
- (j) Add double step capability to circuit board.
- (k) Rewiring of CEM units to amplifiers and harness.

3.3.3 Electron Spectrometer

- (a) Construct two new electronics boards.
- (b) Rewiring of electronics to experiment.

3.3.4 Side Viewing Photometer

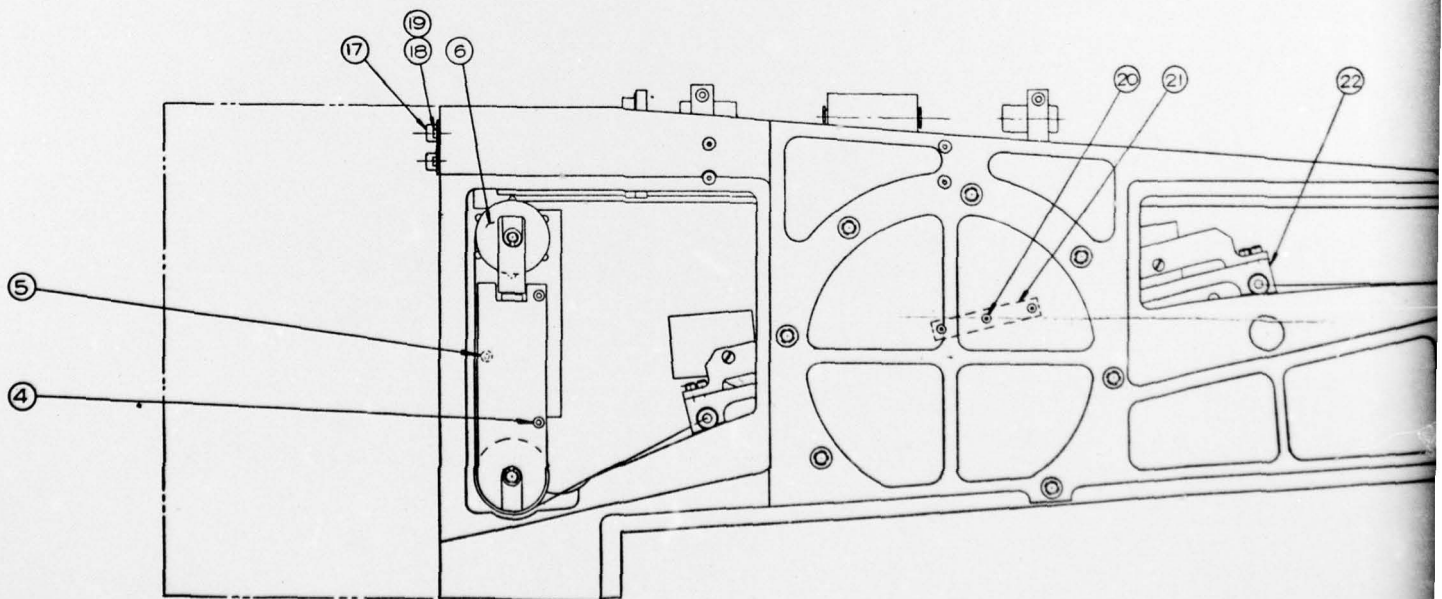
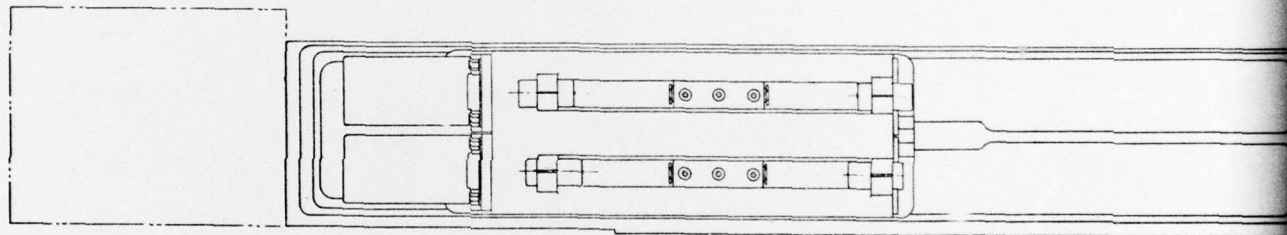
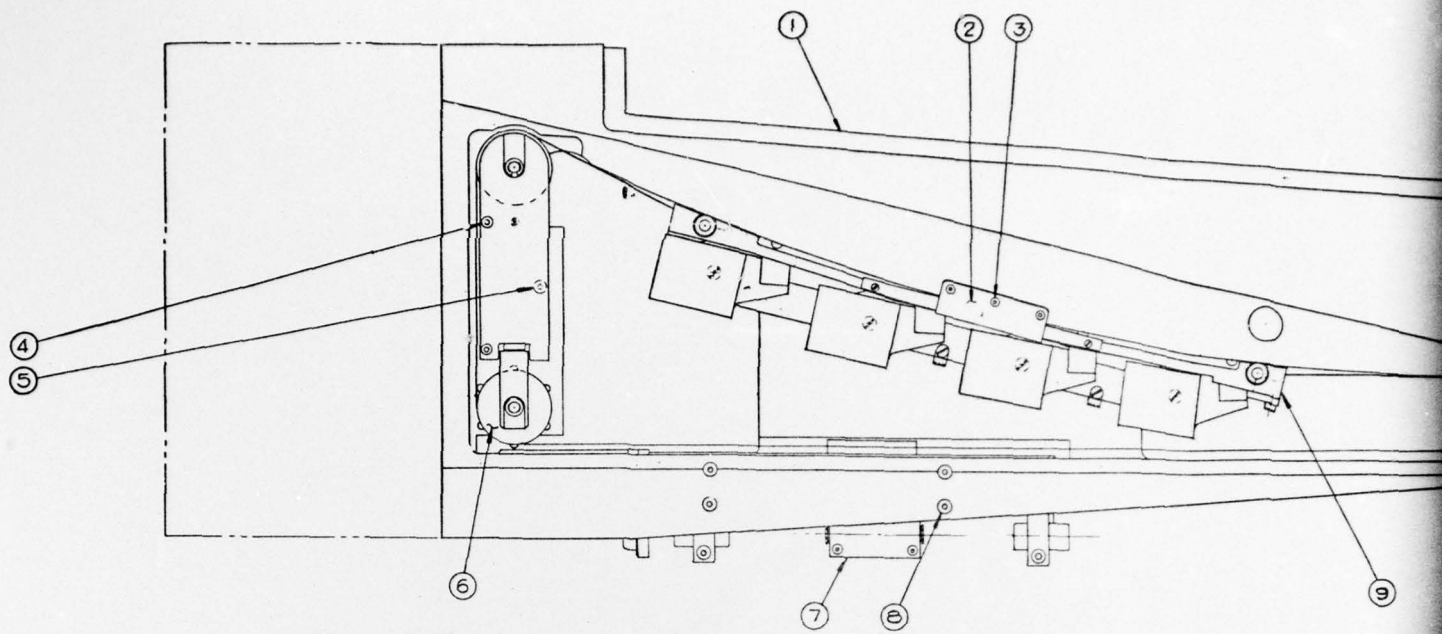
The electronics boards and detector assembly as an auxiliary experiment of RM-60 were removed from the original housing and relocated in another section of the rocket payload in RM-60-B without any electronics board changes.

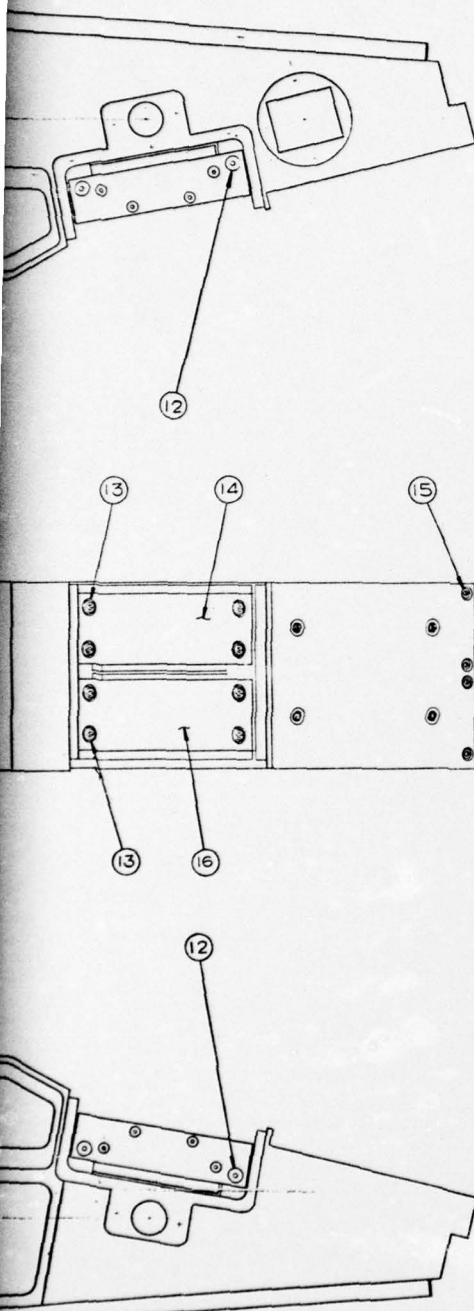
3.4 Assembly

3.4.1 RM-60-B (Mechanical)

Eight new CEM detectors (two having MgF_2 coated cones) were positioned into the stripped Kel-F holders from which the original eight detectors were removed. They were potted into place, assembled with and wired to their respective amplifiers and plateaues prior to assembly and wiring on their respective carriages. An optical alignment test was carried out on each deck, wherein the exit slits were adjusted parallel to their respective entrance slit prior to calibration. An internal assembly drawing, Figure 1, illustrates the design of the original instrument. Item 22 (Channeltron carrier assembly of bottom deck) has been replaced during this modification by the assembly illustrated in Figure 2.

Table I lists the technical characteristics of the modified instrument.





22	CHANNELTRON CARRIER ASSY (BTM DECK)	D 799			1
21	GUIDE RAIL TRAP	A 2655-1			1
20	BUTTON HD SCREW	#2-36UNC x .60	ST. STL		3
19	HEX NUT	#2-40UNC	ST. STL		4
18	PAN HD SCREW	#4-40UNC x .75	ST. STL		4
17	CONNECTOR	DAM 155	ITT CALVON		2
16	GRATING MOUNT ASSY	C 1225-2			1
15	SOC HD CAP SCREW	#4-40UNC x .60	ST. STL		4
14	GRATING MOUNT ASSY	C 1225-1			1
13	SOC HD CAP SCREW	#6-32UNC x .75	ST. STL		6
12	BUTTON HD SCREW	#6-32UNC x .60	ST. STL		4
11	HEAD PULLEY ASSY	C 1227			1
10	FLAT HD SCREW	#6-40UNC x .60	ST. STL		4
9	CHANNELTRON CARRIER (TOP DECK)	D 798			1
8	BUTTON HD SCREW	#6-32UNC x .60	ST. STL		8
7	BELT DRIVE ASSY	D 800			1
6	TAKE-UP PULLEY ASSY	C 800			2
5	SOC HD CAP SCREW	#6-32UNC x .60	ST. STL		2
4	SOC HD CAP SCREW	#4-40UNC x .60	ST. STL		4
3	SOC HD CAP SCREW	#2-56UNC x .50	ST. STL		3
2	GUIDE RAIL TRAP	A 2307			1
1	MONOCHROMATOR HOUSING	E 389			1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES SURFACE FINISH		CONTRACT NO. 73-0253	DATE 06-07-1973	COMSTOCK & WESCOTT, INC. CAMBRIDGE, MASSACHUSETTS	
TOLERANCE: DECIMALS .015 FRACTIONS .005 DO NOT SCALE THIS DRAWING		DESIGNED BY G.W. GUAY	CHECKED BY [Signature]	APPROVED BY [Signature]	
MATERIAL 5032		INTERNAL ASSEMBLY MODEL 5032 EUV SPECTROMETER			
REVISION	USED ON	PROTECTIVE FINISH	APPROVED	31561	E 391

9 Figure 1. Internal Assembly Model 5032 EUV Spectrometer

3

TABLE I
 TECHNICAL CHARACTERISTICS OF ROCKET SPECTROMETER NO. 60-B

	Top Deck	Bottom Deck
Entrance Slit	$\left\{ \begin{array}{l} .0508 \text{ mm (Flight)} \\ .127 \text{ mm (Calibration)} \end{array} \right\}$.0508 mm
Grating	1200 ℓ /mm gold replica	300 ℓ /mm gold replica
Exit Slit	$\left\{ \begin{array}{l} .0508 \text{ mm (Flight)} \\ .127 \text{ mm (Calibration)} \end{array} \right\}$.127 mm
Detectors	4 CEM (MgF_2 coated cones on two shortest wavelengths)	4 CEM
Wavelengths Covered	55 \AA - 310 \AA	284, 630, 915, 1206 \AA
Steps per Scan	1400	30
Distance per step	.06096 mm	.127 mm
Duration of Scan	\sim 140 sec	3 sec
Stepping Rate	10 steps per sec	10 steps per sec (double step)
Resolution	0.22 \AA FWHM	2.2 \AA FWHM
Slit Height Limiter	5 mm	5 mm

3.4.2 RM-60-B (Electronics)

The frame rate (or scan step rate) of the bottom deck was changed from 100 frames per second to 10 frames per second by adding a 10:1 frequency divider to the timer circuit of the motor drive/timer printed circuit card. The motor drive section of the same board was also modified to step the motor twice during each frame. A schematic of the updated motor drive/timer board is given in Figure 3. A timing diagram for the modified instrument is given in Figure 4.

3.4.3 Auxiliary Experiments

The auxiliary experiments originally built for RM-60 were used on RM-60-B. However, the analyzer voltage steps of the electron spectrometer were changed from the original ones and a new circuit board was required. The new step generator/drive schematic is illustrated in Figure 5. Since the electronics cards were mounted on top of the instrument in RM-60-B rather than in the detector assembly at the rear of the electronics package (RM-60), the five electronics boards were redesigned and incorporated into two newly constructed cards.

As mentioned previously, the photometer cards built for RM-60 were used for RM-60-B but were mounted with the photometer detector in a new rocket extension below the main instrument.

3.5 Test and Delivery

Prior to delivery to AFGL, a preliminary acceptance test was carried out at Comstock & Wescott. This test included the operation of the instrument with the GSE through all of the necessary bench functions. An addendum to the previous "Test and Acceptance Plan for RM-60" was submitted to AFGL to encompass the modification introduced into the operation of the instrument. The instrument was delivered to AFGL for further acceptance testing and calibration. No launch support services were supplied under this contract.

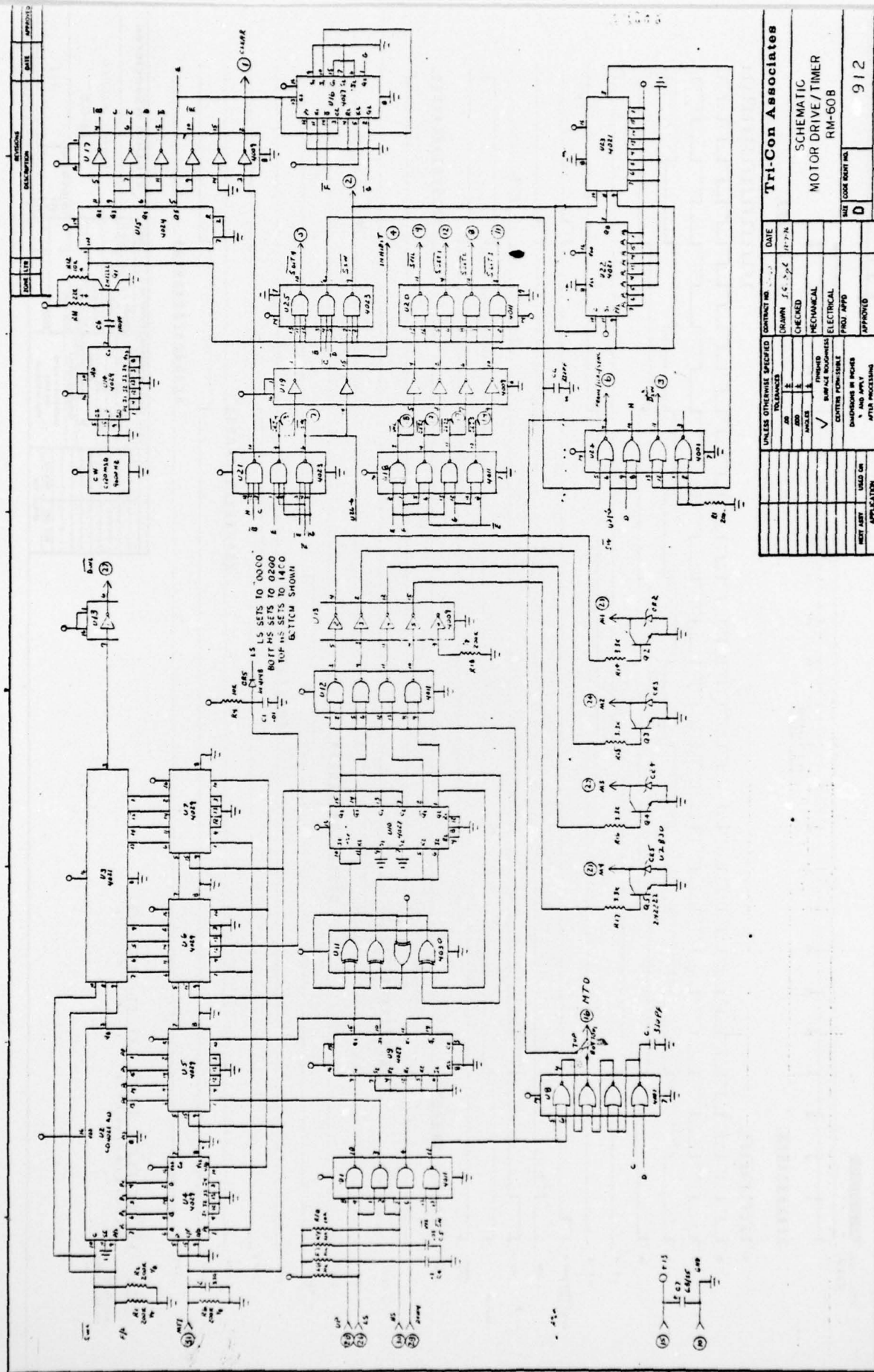
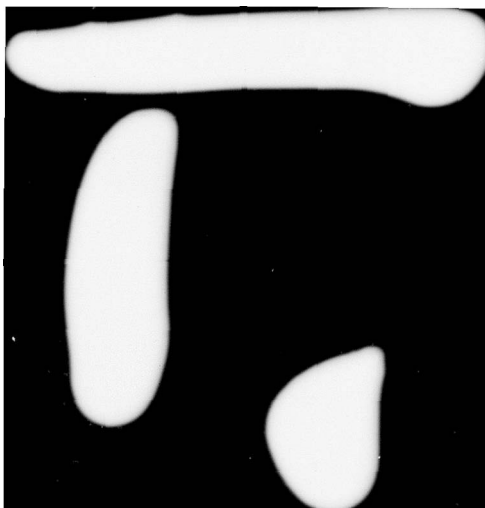


Figure 3. Schematic Motor Drive/Timer RM-60B

UNLESS OTHERWISE SPECIFIED		DATE
DESIGNER	DATE	11-7-78
CHECKED	DATE	
MECHANICAL	DATE	
ELECTRICAL	DATE	
PROJ. APPD.	DATE	
APPROVED	DATE	
REVISIONS		
NO.	DESCRIPTION	
1	INITIALS	
2	DATE	
3	DATE	
4	DATE	
5	DATE	
6	DATE	
7	DATE	
8	DATE	
9	DATE	
10	DATE	
11	DATE	
12	DATE	
13	DATE	
14	DATE	
15	DATE	
16	DATE	
17	DATE	
18	DATE	
19	DATE	
20	DATE	
21	DATE	
22	DATE	
23	DATE	
24	DATE	
25	DATE	
26	DATE	
27	DATE	
28	DATE	
29	DATE	
30	DATE	
31	DATE	
32	DATE	
33	DATE	
34	DATE	
35	DATE	
36	DATE	
37	DATE	
38	DATE	
39	DATE	
40	DATE	
41	DATE	
42	DATE	
43	DATE	
44	DATE	
45	DATE	
46	DATE	
47	DATE	
48	DATE	
49	DATE	
50	DATE	
51	DATE	
52	DATE	
53	DATE	
54	DATE	
55	DATE	
56	DATE	
57	DATE	
58	DATE	
59	DATE	
60	DATE	
61	DATE	
62	DATE	
63	DATE	
64	DATE	
65	DATE	
66	DATE	
67	DATE	
68	DATE	
69	DATE	
70	DATE	
71	DATE	
72	DATE	
73	DATE	
74	DATE	
75	DATE	
76	DATE	
77	DATE	
78	DATE	
79	DATE	
80	DATE	
81	DATE	
82	DATE	
83	DATE	
84	DATE	
85	DATE	
86	DATE	
87	DATE	
88	DATE	
89	DATE	
90	DATE	
91	DATE	
92	DATE	
93	DATE	
94	DATE	
95	DATE	
96	DATE	
97	DATE	
98	DATE	
99	DATE	
100	DATE	

Tri-Con Associates
 SCHEMATIC
 MOTOR DRIVE/TIMER
 RM-60B
 SIZE CODE RM-60B
 D 912



AD-A045 018

COMSTOCK AND WESTCOTT INC CAMBRIDGE MASS
MODIFICATION OF A SOLAR EUV SPECTROMETER.(U)
JUL 77 J F MCGRATH, J P PADUR

F/G 14/2

UNCLASSIFIED

AFGL-TR-77-0145 F19628-76-C-0041
NL

2 OF 2

AD
A045 018

SUPPLEMENTARY

INFORMATION

END

DATE
FILMED

1 -78

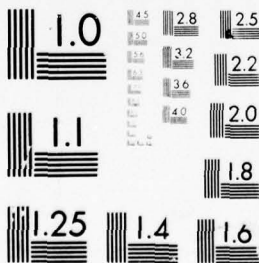
DDC

SIFTED

2 OF 2

AD

A045018



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SUPPLEMENTAL

INFORMATION

AD-A045018

AFGL-TR-77-0145
Final Report
F19628-76-C-0041

MODIFICATION OF A SOLAR EUV SPECTROMETER
John F. McGrath
Joseph P. Padur

Errata

Delete the name of John F. McGrath
from the cover and Block 7 of the
DD Form 1473.

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731